Space Weather Technical Forecast

Issued on Thursday, 30 May 2024 at 12:13 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Ongoing likelihood of M-class flares, and chance of isolated X-class flares. Chance of G1-G2/Minor to Moderate geomagnetic storm activity on Day 3 (1 June).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity reached High levels during the last 24 hours, following a long duration X1.4 flare at 29/1437UTC from AR3697 in the southeast. This region also produced several other M-flares. In addition, AR3691 in the north-centre disc produced an M5.7 flare at 29/1841UTC.

There are currently seven numbered and two un-numbered regions on the visible disc. The most notable are AR3691 (Dkc/Beta-Gamma-Delta) in the northeast and AR3697 (Eki/Beta-Gamma-Delta) in the southeast. AR3691 is a fairly large bi-polar group with a clear, albeit weak delta spot, showing only minor development currently. AR3697 continues to move towards a less oblique viewing angle, but currently remains somewhat difficult to fully assess due to its location. However, this appears to also be a fairly large and complex region, with mixed magnetic polarities and a likely delta spot, along with some notable magnetic looping evident above the spot in SDO imagery. The other regions on the disc are small, simple and either stable or declining.

Initial modelling of the CME following the X1.4 flare indicates the chance of a glancing blow in the first half of Day 3 (1 June), with most of the ejecta expected to pass behind Earths orbit. This may be adjusted once further coronagraph imagery is available to give a fuller analysis. There were no other potentially Earth-directed CMEs observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds were indicative of slow wind conditions, with background speeds observed by ACE at L1, around or below 370km/s, and density near or below average. Interplanetary Magnetic Field (IMF), Bt, was moderate initially before dropping back to being weak from 30/0041 UTC. Over the whole period it ranged between 1-11T. The north-south component, Bz, was predominately positive (northward) initially, until the UTC evening, when switching to negative (southward), and ranging between -6nT to +7nT. Phi angle was mostly positive (away from the Sun) throughout, becoming weakly negative for brief intervals (towards the Sun) from 30/0952 UTC. Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 (greater than 10 MeV) remained at Background. High energy electron flux (greater than 2MeV) at GOES16 varied between Background and Moderate. Associated 24-hour fluence remained steady and below the Active threshold. Observed fluence at 30/0000 UTC was 7.92e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High activity is expected with the active sunspot regions in the southeast, AR3697, and north-centre disc, AR3691, the most likely sources.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Solar Wind / Geomagnetic Activity: Analysis is ongoing for the CME following the X1 flare, with initial modelling indicating the chance of a glancing blow in the first half of Day 3 (1 June). This may be adjusted once further coronagraph imagery is available to give a fuller analysis. There were no other potentially Earth-directed Coronal Mass Ejections (CMEs) observed in available imagery.

Solar winds are likely to persist at background through Day 1 (30 May) and much of Day 2 (31 May). Day 3 (1 June) has a chance of a glancing CME from the X1 flare. Otherwise, small coronal hole CH41/+ could give just a modest increase in solar winds later in the period.

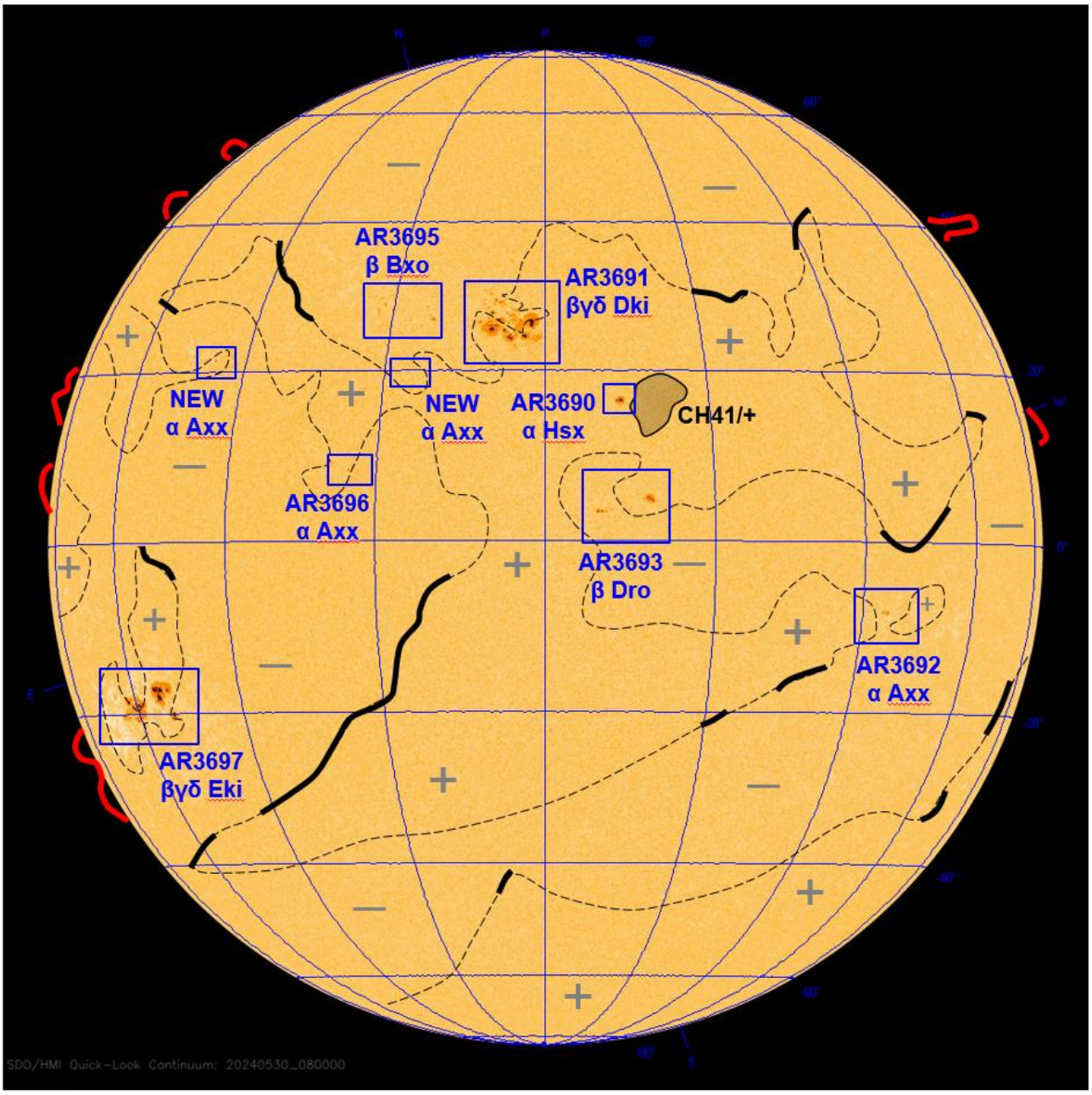
Geomagnetic activity is expected to be mainly Quiet (Kp 0-2) until Day 3, when there is a chance of increasing to perhaps G1-G2/Minor to Moderate storm levels (Kp 5-6). Otherwise, some Unsettled periods may develop later in the period due to modest coronal hole influence.

Energetic Particles / Solar Radiation: High energy proton flux is expected to persist at background, with a slight chance of rising towards the S1 threshold given any further notable flares. The chances for a solar radiation storm will gradually increase as the two most active regions in the eastern hemisphere transit westwards into more favourable geoeffective longitudes. High energy electron flux is also forecast to persist at mainly background. The associated 24 hour fluence is expected to remain below Active.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 1. Solar Analysis Valid 30/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms:

Analysis is ongoing for the CME following the X1 flare, most of the ejecta looks to be directed behind Earth orbit. Initial modelling indicates the chance of a glancing blow in the first half of Day 3 (1 June). This may be adjusted once further coronagraph imagery is available to give a fuller analysis. There were no other potentially Earth-directed Coronal Mass Ejections (CMEs) observed in available imagery.

Solar winds are likely to persist at background through Day 1 (30 May) and much of Day 2 (31 May). Day 3 (1 June) has a chance of a glancing CME from the X1 flare. Otherwise, small coronal hole CH41/+ could give just a modest increase in solar winds later in the period.

Geomagnetic activity is expected to be mainly Quiet (Kp 0-2) until Day 3, when there is a chance of increasing to perhaps G1-G2/Minor to Moderate storm levels. Otherwise, some Unsettled periods may develop later in the period due to modest coronal hole influence.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	20	40	10
Strong	G3	No	1	5	10	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

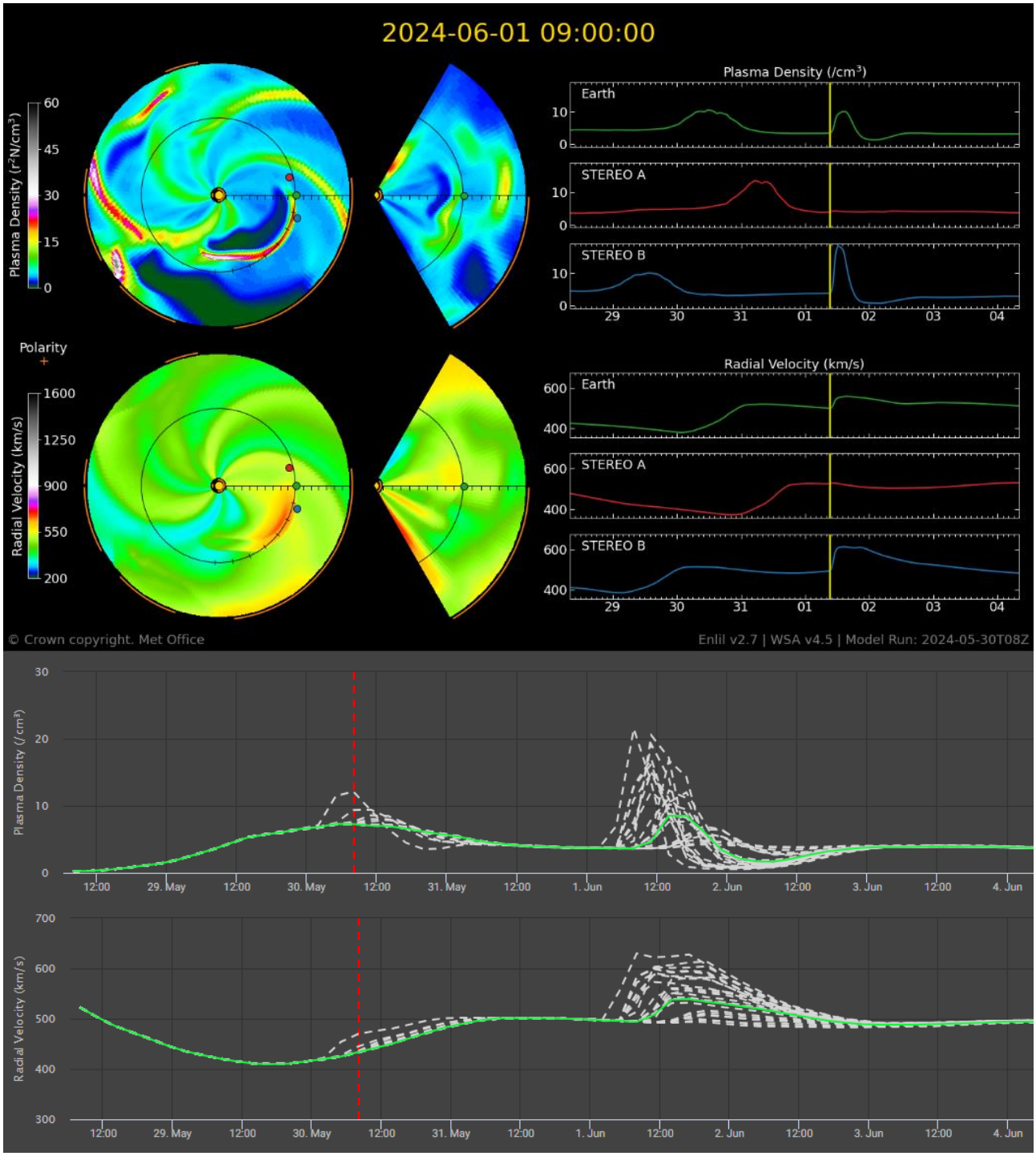
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
29/2008	Partial Halo	X1.4 flare	SE	647 km/s	01/0700	Initial analysis only at present. Chance of glancing blow.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 2: MOSWOS Enlil and Ensemble models showing potential arrival time of CME glance. Note Enlil likely over-doing coronal hole fast winds from 30 May.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

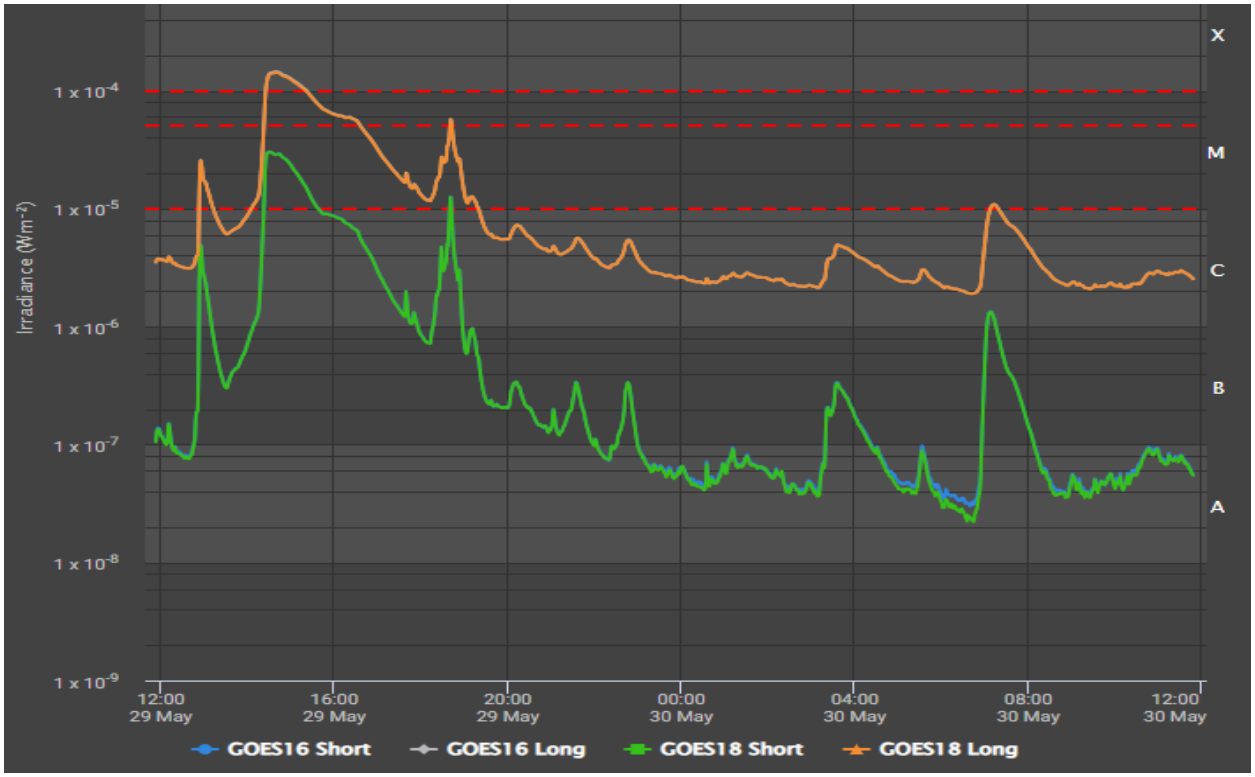
© Crown Copyright 2024. All Rights Reserved.

Radio Blackouts - X-Ray Flares:
Moderate to High activity is anticipated, with the two notable sunspots (AR3697 and AR3691) the most likely sources for further significant flares.

There are currently seven numbered and two un-numbered regions on the visible disc. The most notable are AR3691 (Dkc/Beta-Gamma-Delta) in the north-centre disc and AR3697 (Eki/Beta-Gamma-Delta) in the southeast. AR3691 is a fairly large bi-polar group with a clear, albeit weak delta spot, showing only minor development currently. AR3697 continues to move towards a less oblique viewing angle, but currently remains somewhat difficult to fully assess due to its location. However, this appears to also be a fairly large and complex region, with mixed magnetic polarities and a likely delta spot, along with some notable magnetic looping evident above the spot in SDO imagery. The other regions on the disc are small, simple and either stable or declining.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	80	80
Very Active	R3 to R5 X Class	Yes	25	25	25	25

Figure 3: GOES 16 & 18 X-ray flux.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
GOES-18 proton flux is expected to persist at background, with a slight chance of rising towards the S1 threshold given any further notable flares. These are most likely from either AR3697, which is currently close to the southeastern limb, or AR3691 in the northeast quadrant. The chances for a solar radiation storm will gradually increase as these regions transit westwards into more favourable geoeffective longitudes.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	15	20
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

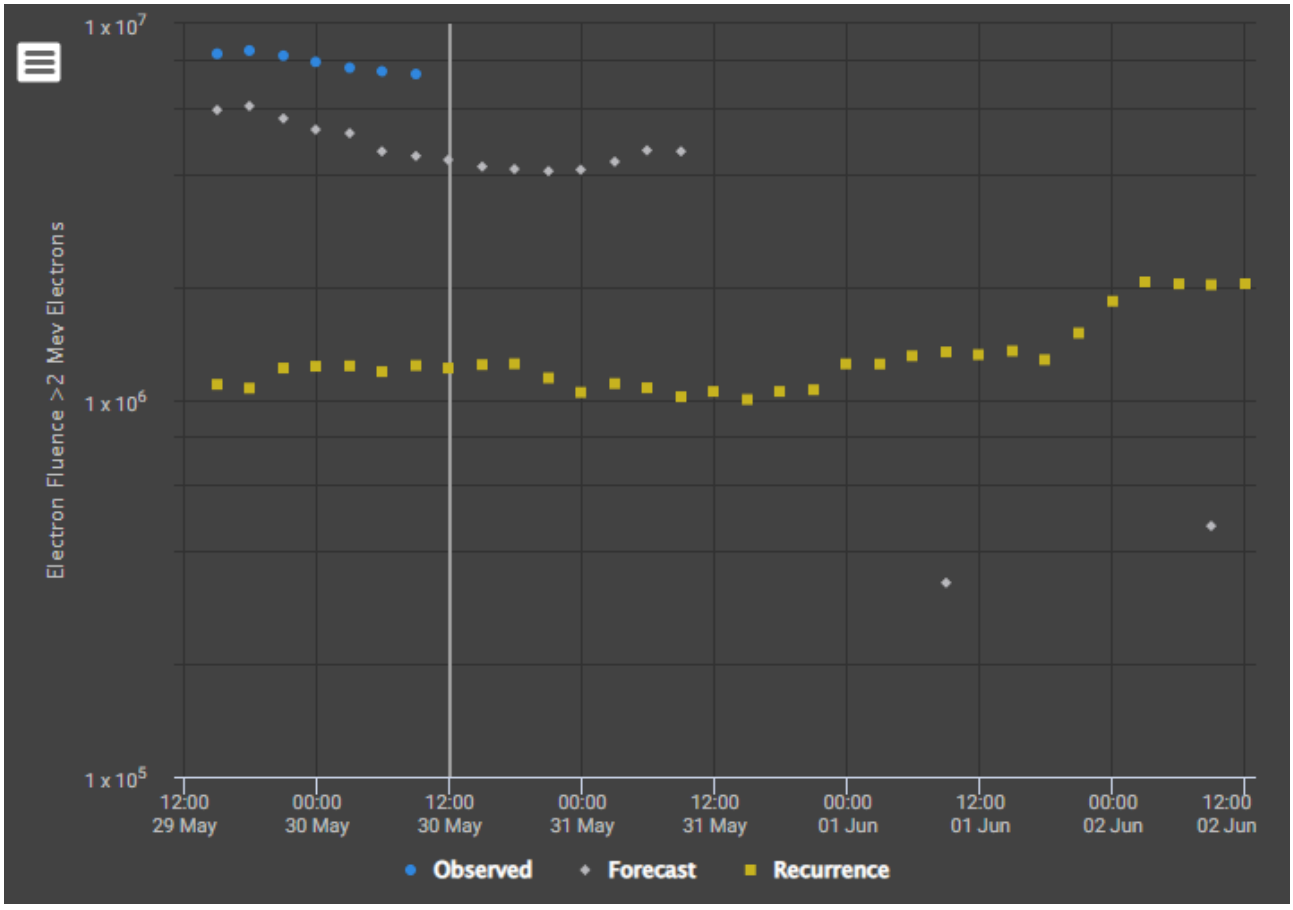
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
GOES-16 electron flux is expected to remain mainly at background with brief diurnal increases to Moderate, and no significant sources of enhancement anticipated until late in the period. The associated 24 hour electron fluence is expected to remain below the Active level, as supported by MOSWOC REFM, which is giving good guidance for the expected trend through the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM model.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.